

ABSTRACT OF PAPER

ON

DEEP-SEA SOUNDINGS

AND TEMPERATURES IN THE GULF STREAM.

READ BEFORE THE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, AT THE
MEETING HELD AT MONTREAL, AUGUST, 1882.

By COMMANDER J. R. BARTLETT,
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J. R. Bartlett, Commander U. S. Navy.

Hydrographer to the Bureau of Navigation.

Washington, D. C.

DEEP-SEA SOUNDINGS AND TEMPERATURES IN THE GULF STREAM
OFF THE ATLANTIC COAST, TAKEN UNDER THE DIRECTION OF
THE U. S. COAST AND GEODETIC SURVEY. By J. R. BART-
LETT,¹ of Lonsdale, R. I.

[ABSTRACT.]

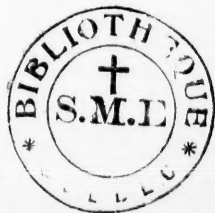
I HAVE come to this meeting of the Association at the kind request of Mr. Hilgard, the Superintendent of the Coast and Geodetic Survey, to tell you of the investigations made by the steamer "Blake."

The hydrographic party of which I have charge, has been investigating the Gulf Stream for the past four years, the last two summers having been passed on our immediate coast. All of you have ideas or pet theories in regard to this great river of the ocean, as Maury has happily called it. Many of our greatest scientists have written learnedly about it. Professor Bache, while he was Superintendent of the Coast Survey, caused extensive and systematic investigations to be made of its physical features. From the data obtained, the Stream was assumed to start from the Caribbean sea, making the circuit of the gulf of Mexico, and to issue with great velocity and high temperature from the straits of Florida, continuing to about latitude 45°N. It was described as a superficial stratum of warm water flowing over one of cold, with banks of cold water, and divided or bifurcated into warm and cold bands.

The bifurcation was explained by the presence of hills and valleys which were developed by the soundings, the cold water being said to be in the valleys and the warm water on the elevations. As no soundings were obtained in the strength of the current, it was supposed that the stream ran over, if not in, a great trough or depression of the sea-bed. At the time the investigations were made under the direction of Professor Bache, the means of obtaining the depth of the sea were very imperfect; now we have the most improved apparatus and soundings can be taken with wire in any current and to any depth with almost perfect accuracy.

The investigations made on board the "Blake" show conclusively that the above assumptions are wholly erroneous. My

¹ Commander U. S. Navy.



soundings give no channel for the Stream to run in, there are no hills or valleys, and I have never found any bifurcation or warm and cold bands. The temperatures obtained do not show cold water beneath the Stream, but a current of warm water between the Florida straits and cape Hatteras down to the very bottom.

As has already been stated to this Association by Mr. Hilgard, the current entering the gulf of Mexico from the Caribbean sea does not make the circuit of the gulf as formerly supposed, but passes to the northward and eastward in the same general trend as the Yucatan plateau, and thence to the straits of Florida.

The lines of soundings taken by the "Blake" were twelve in number, beginning at Jupiter inlet, Florida, and extending to Currituck, N. C. They were run normal to the general coast line.

The soundings give very interesting data in regard to the physical features of the bottom of the ocean over which the Gulf Stream flows. Instead of a deep channel in the course of the Stream, as reported by Lieutenants Maffitt and Craven, and published in the Coast Survey Reports, our later soundings with *wire* show an extensive and nearly level plateau extending from a point to the eastward of the Little Bahama banks to cape Hatteras. Off cape Canaveral this plateau is nearly 200 miles wide, and gradually contracts in width to the northward until reaching Hatteras, where the depth is more than 1,000 fathoms within 30 miles of shore. The plateau has a general depth of 400 fathoms, suddenly dropping off on its eastern edge to over 2,000 fathoms.

The course of the Gulf Stream can be traced by a study of the specimens of the bottom obtained; on each side of the Stream the sounding cylinder brought up ooze, but in the strength of the current the bottom was washed as bare of ooze and all living things as the bed of a mountain torrent. Instead of a cushion of cold water at the bottom, the temperatures were the same as those found at the corresponding depth of 400 fathoms in the Windward passage and in the course of the current through the Caribbean sea and gulf of Mexico.

The temperature of the surface-water was taken every mile on all lines and in no case were there found any warm or cold bands. There was a slight rise of temperature on entering the current, at the surface, and also a corresponding rise at the bottom in the

same locality. The surface temperatures found in the Stream were much below those generally given in published works on the subject. The average temperature in the axis of the Stream rarely exceeded 83°F . in June and July. On one or two occasions the thermometer read as high as 86° , and once 89° , but it was at high noon in a dead calm. The temperature at five fathoms did not range above the average of $81\frac{1}{2}^{\circ}$. The surface temperatures did not indicate a cold wall inside of the Stream; the water between the one hundred fathom-line and the shore seemed to be an overflow of the Stream, as the temperatures at five, ten and fifteen fathoms were nearly as high as those found in the Stream.

Lines for series of temperatures from the surface to the bottom were run during the past summer from Block island to the Bermudas, and thence to Hatteras. The isothermals show the Labrador current until nearing the Stream, when they descend gradually and in the stream itself abruptly, to their greatest depths. Instead of the warm stream-water thinning away as it was reported to do when spread out, it was not much over fifty miles in width at the time of our crossing, as shown by the current and high surface temperatures. The temperatures below the surface were much higher than at the same depths off the coast.

The ordinary temperature at the bottom off Savannah and Charleston in 400 fathoms was 45° . In the Stream between Block island and the Bermudas it was as high as 55° at 400 fathoms. The isothermals remained at almost the same depth to the southward, as in the Stream, on the entire line to the Bermudas. Just north of the Stream the temperature at 400 fathoms was $39\frac{1}{2}^{\circ}$ and 40° . At a point well in the Labrador current away from the Stream, the temperature at 400 fathoms was $38\frac{1}{2}^{\circ}$.

From the Bermudas to Hatteras the isothermals were at the same depths as were found south of the Stream on the previous line, but when in the current off Hatteras, where the Stream trends to the eastward, they rose to the same depth as off Charleston and Savannah on the plateau.

These temperatures below the surface seem to suggest that the Labrador current underruns the Stream at Hatteras, but at no other point. It probably keeps its natural boundary or western wall along the 1,000 fathom curve, and thus follows around the plateau towards the equator. No definite conclusion can be drawn

from the data obtained thus far; but we have at least a clear field to work upon in the future, in regard to temperatures and currents, and the contour of the bottom as far as Hatteras is well portrayed.

Tables are appended giving the depths, etc., found on the several lines.

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LINE A. FROM JUPITER INLET, FLA., TO MEMORY ROCK.

LINE B. FROM SHORE, LATITUDE $27^{\circ} 57'$ N. TO LAT. $27^{\circ} 57'$ N.

LINE B. FROM SHORE, LATITUDE $27^{\circ} 57'$ N. TO LAT. $27^{\circ} 58'$ N.

LINE C. FROM SHORE LATITUDE 282 40' N. TO LAT. 2

LINE D, FROM SHORE, LATITUDE 29° 25' N. TO LAT. 29°

LINE E. FROM ST. JOHN'S RIVER, FLA. TO LAT. 30° 30'

LINE E FROM TYBEE ROADS GA. TO LAT. 30° 51'

8.1.9	8.1.9	8.1.9	8.1.9	8.1.9
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44°	45½	44¼	45°	40¼
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43°	44°	45°	38½°	46°
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43°	45°	46°	45°	44°
-----	-----	-----	-----	-----

1955	1956	1957	1958	1959
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37°	38½°
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38°	37½°	37°	37°	...
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NOTE.—The distance between soundings are given in nautical miles, the first sounding being measured from the shore. The abbreviations from character of bottom are: Fne., fine; bk., black; gy., grey; wh., white; s., sand; sh., shells; g., green mud; br., brown mud; c., coral; co., corals; r., rocks; sp., sponge; st., seaweed; v., vegetation; l., light; d., deep; s., sand; sh., shells; g., green mud; br., brown mud; c., coral; co., corals; r., rocks; sp., sponge; st., seaweed; v., vegetation; l., light; d., deep.

	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2
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[illegible][illegible]

PE ROMAN, S. C., TO LAT. 30° 59' N., LONG. 77° 17' W.															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Co. R.	Co. R.	Co. R.	Co.	Co.	Co.	Co.	Co.	Co.	Co.	Co. S.	C.S.	Ptd. oz.	Ptd. oz.	Ptd. oz.	Ptd. oz.
82½	83	82½	82	82½	83	83	82	82½	81½	81½	81½	81½	81	81½	81
44½	45	46½	48	51½	53	53	54	47	47	46	47	47	47	47	47

[illegible]

CAPE FEAR, TO LAT. 32° 05' N., LONG. 76° 09' W.														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
250	280	310	338	364	380	410	434	459	492	535	605	729	959	1189
8.	Bk., wh. S.	Bk., wh. S.	Glob.	Glob.	Glob.	Glob. oz.	Glob. oz.	Glob. oz.	Glob. oz.	Glob. oz.	Glob. oz.	Glob. oz.	Glob. oz.	Glob. oz.
84½	84½	84½	84½	84½	84½	84½	84½	84½	84½	84½	84½	84½	84½	84½
46½	45½	44½	41½	42½	43½	43½	42½	42½	40½	40½	39½	38½	37½	37½

[illegible][illegible][illegible]

re: Enc., fine; bk., black; gy., grey; wh., white; rd., red; gn., green; brk. Sh., broken shells; S., sand; G., gravel; sp., speck; Co., coral; Co. R., coral rock; Ptd. oz., Pteropod ooze; Glob. oz., Globigerina ooze. m in the daytime. As mentioned in the essay, the direction of the current was very much influenced by direction and force of the wind.